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Tall fescue (Festuca arundinacea Schreb.) is a versatile perennial grass. Often referred to simply as "fescue," it is easy to establish, tolerant of a wide range of management regimens and a good forage yielder. Laboratory nutritive analyses of fescue compare favorably to those of other cool-season grasses.

Fescue was first planted on a widespread basis in the U.S. in the 1940's, and now occupies some 35 million acres in the Eastern half of the country. Since the discovery in the late 1970's that an endophyte (fungus) within this grass affects both grazing animals and the grass itself, attitudes toward fescue have changed greatly. This publication provides a review of current knowledge of the effects of endophyte-infected (EI), as compared to endophyte-free (EF) fescue and explains options livestock producers have for using this important grass.

Livestock Disorders

While fescue has numerous desirable attributes, there are several livestock disorders that are now recognized to be associated with it under some circumstances.

Fescue Foot

"Fescue foot" is a dry, gangrenous condition of the extremities of the bodies of cattle consuming fescue. Usually it causes lameness or the loss of the tips of tails or ears, but may result in sloughing of hooves or feet. Animal gains also are reduced. Fescue foot is generally associated with cold weather.

Bovine Fat Necrosis

Bovine fat necrosis is characterized by the presence of masses of hard fat in the abdominal cavities of cattle. This fat can cause digestive or calving problems. It is more prevalent in the southern U.S. states where pastures are essentially pure fescue and have been heavily fertilized with poultry litter or nitrogen fertilizer.

Fescue Toxicosis or Summer Syndrome

The signs of fescue toxicosis include: *(1) reduced feed intake; (2) lower weight gains; (3) decreased milk production; (4) higher respiration rates; (5) elevated body temperatures; (6) rough hair coats; (7) more time spent in water and/or shade; (8) less time spent grazing; (9) excessive salivation; (10) excessive blood serum prolactin levels;* and (11) *reduced reproductive performance.* Some or all of these responses have been observed with dairy cattle, beef cattle and sheep. Fescue toxicity is of widespread occurrence and of much economic importance in the regions where fescue is grown and used for forage.

The Endophyte Fungus

The endophyte fungus *Acremonium coenolphialum* was not associated with animal disorders until the late 1970's. Since then our understanding of the potentials of fescue in livestock production has increased greatly. Two characteristics of the endophyte have great practical importance. First, the fungus lives within fescue plants and does not affect the appearance of the grass. A laboratory analysis is required to detect its presence. Secondly, it does not spread like an 'infectious' fungus, but rather is transmitted only by seed. Thus, once an endophyte free (EF) stand is established, it will remain non-infected unless infected seed (either present before seeding EF fescue or introduced later) germinate and become established.

Endophyte Effects On Animals

Grazing Time

Animals on endophyte infected (El) pastures spend less time grazing during the day and more time grazing at night. Some studies show that the effect can persist up to one month after the animals are removed from EI fescue pastures.

Intake and Digestibility

Cattle have been shown to prefer EF fescue over EI fescue.. Much, but not all, of the reduction in livestock average daily gain (ADG) or gain per unit area of land on El fescue is due to reduced feed intake. Once eaten, though, the alkaloids present in EI fescue do not appear to have a major effect on ruminal microbial digestion. Digestibility and crude protein content are similar in El and EF fescue.

Effects on Beef Yearling Gains

Research shows that decreased gains of steers grazing El forage are widespread, quite uniform and not limited to certain geographic areas or management conditions.

Fescue toxicosis is commonly referred to as "summer syndrome" or "summer slump" because visible signs are most pronounced during hot weather. Steer ADG has been shown to decrease about 0.1 lb for each 10% increase in fescue infection rate. Increased nitrogen (N) fertilization does not affect steer ADG on El fescue. However, N fertilization of El fescue can increase gain per acre because of higher stocking rates.

Effects on Beef Cows and Calves

Beef cows grazing El fescue often lost weight, have lower pregnancy rates, and their nursing calves had slower gains and reduced weaning weights compared to those grazing EF pastures. A decline in body condition can affect reproduction lead to a long interval between calving and first estrus. Therefore, cows entering the breeding season in a poor or negative gaining condition because of EI fescue probably will have a prolonged post-partum interval regardless of later endophyte effects.

Supplemental feeding (in the form of either clover or grain) of cattle on El fescue can improve pregnancy rates, but not up to economically acceptable levels. Thus, it appears that factors other than nutrition are involved in the reduced pregnancy rates associated with El fescue.

Effects on Beef Heifers
Limited Alabama research showed that heifer ADG decreased as infection level increased. However, heifers were observed in estrus prior to their first breeding, but pregnancy rates decreased as infection level increased. Following first calf births, pregnancy rates were further reduced in heifers grazing pastures with medium and high infection levels, but not in those grazing low-endophyte pastures. Initiation of the estrus cycle in heifers grazing El fescue is not delayed, and cessation of the estrus cycle in animals already cycling does not occur. This research indicates that conception is not affected by the endophyte. Reduced calving percentages of cattle on El fescue appear to be due to early embryonic death

Feedlot Gains of Steers That Previously Grazed Fescue
Because of their unthrifty appearance, steers that have grazed El fescue often bring reduced prices, making it important to determine whether there are carryover effects on feedlot performance. Studies in Georgia, Arkansas, Oklahoma and Tennessee indicate that when steers grazed on EI fescue arrived at a feedlot during cooler weather, they gained faster than steers which had grazed EF fescue, especially during the first 28 days. Steers arriving during hot weather did not show increased gains, but their gains were not reduced as a result of previous exposure to El fescue.

Effects on Milk Production
Consumption of El fescue can lead to reduced milk production in beef cows.
Milk production of lactating dairy cows can be sharply reduced even when fescue has low infection levels, but EF fescue provides excellent nutrition for lactating animals. Milk production by dairy cows consuming EF fescue was similar to those grazing alfalfa-orchardgrass in Kentucky, and annual ryegrass in Alabama. Differences in milk production appear to be primarily due to differences in intake.

Effects on Horses Several studies have provided evidence that the fescue fungus is associated with number of horse reproductive problems, reduced conception rates, gestation lengths, Increased foaling problems, foal deaths, retained placentas, foal weights, and the reduction in numbers of mares lactating, and foal survival.

A striking difference between horses and cattle is the lack of carryover effects when mares are removed from EI pastures. Horses respond rapidly to EF fescue and have a rapid turnover of toxicants, allowing them to quickly overcome the negative effects. Conversely, lactating mares moved onto EI fescue will cease lactating within a few days. Mares removed from El fescue one month before foaling can often recover from fescue toxicosis and have normal foals. The prevalent recommendation to producers, however, is that mares be removed from El fescue 60 to 90 days before anticipated foaling. Grain supplementation to mares grazing EI fescue has no benefit with regard to endophyte effects.

Effects on Thermoregulation
The alkaloid toxicant acts as a vasorestrictor. (constriction of the blood vessels) . Cattle consuming El fescue typically have difficulty dissipating heat and exhibit hyperthermia (abnormally high body temperature) as shown by increased rectal temperature, particularly when the ambient temperature exceeds 88^0F. Increased respiration rates (often evidenced by panting) probably helps animals to cool themselves and dissipate the increased heat load. Excessive salivation, also a sign of fescue toxicosis may be due to the panting.

In cool environments, animals on an El diet exhibited symptoms of poor blood circulation; reduced temperatures at the extremities (ear tips, tail tip, hooves). This hypothermia (reduced temperature) in animals consuming El fescue is also consistent with vasoconstriction. This reduced blood flow in the extremities is likely also associated with the fescue foot syndrome.

Endophyte Effects on the Fescue Plants
Several studies have shown that insect species prefer and/or develop more rapidly on EF fescue and that the alkaloids in El fescue are associated with increased resistance to insect feeding . A difference in vigor has been observed between El and EF fescue pastures in some environments. This has usually been seen only in new plantings, but in stressful environments (Southern U.S. states which are marginal areas for growing fescue), stand loss was greater in established EF pastures. El is also more drought-tolerant than EF fescue. These findings have important implications. First, while fescue is regarded as a forage crop which is easy to establish, that may be less accurate when the fescue is EF. Thus, when planting EF fescue, a producer should carefully follow all establishment recommendations. *Overgrazing of EF fescue should be avoided, especially during the establishment year.* Fields to which El fescue is only marginally adapted should not be planted to EF fescue.

Experience has shown that if overgrazing, severe drought or other highly stressful conditions occur, EF fescue will not persist as well as El fescue. However, EF fescue stands which are managed well can persist and remain non-infected for many years.

Seed Production and Seed Labeling
The discovery of the role of the endophyte in reducing, performance of animals-raising on tall fescue pastures resulted in many states establishing a testing and seed tag assurance programs for the identification and marketing of 'Low Endophyte' and 'Endophyte Free' classes of seed. Lots with 5% or less infection receive a state entophyte tag for seed bags.

Strategies For Coping With The Endophyte

Livestock producers who have, or who plan to establish, fescue fields should develop an intelligent "endophyte strategy" based on research findings. The following is a review of options available for avoiding or minimizing endophyte effects.

Dealing With Existing Infected Stands
Producers with established fescue fields need to carefully assess their situations. Existing fescue stands should be tested for endophyte infection on a field-by-field basis. Several states now have

laboratories for determining endophyte level. County agricultural agents can provide information regarding cost, sampling methods, and laboratory addresses.

Once the endophyte level in existing fescue pastures is known, a producer can select the best option for dealing with the problem. The best way to handle one field may not be best for another. Four general approaches are available.

1. *Manage to minimize the effect* Endophyte effects on animals can be minimized with management practices. Grazing and/or clipping management that keeps plants young and vegetative will result in better animal performance. Likewise, if fescue is cut for hay in the boot stage, better animal performance will be obtained than from late-cut hay.

2. *Avoid the Endophyte* Use of other forage species avoids the endophyte. Using El fescue in spring and use of other grasses or grass-legume mixtures for summer grazing will avoid the endophyte during the summer when fescue forage quality is low. Because animal performance is adversely affected by consuming El fescue hay, feeding of hay of another species also can be helpful.

3. *Dilute the Endophyte* The endophyte or its products can be diluted through the use of other feeds in the diet. Growing legumes such as red clover, birdsfoot trefoil or alfalfa with El fescue is a particularly attractive option. Many studies have shown greater live weight gains, and improved (though sometimes still unacceptable) pregnancy rates when pastures are renovated to include legumes.

4. *Prevent the production of infected seed and new infected plants.* In order to prevent later establishment of volunteer infected plants, any El field which is to be replanted should not be allowed to produce seed for a year or more before re-seeding. Seedhead formation should be prevented by heavy grazing, clipping or chemical application.

5. *Kill infected stands and replant* EF seed is now readily available in most areas of the United States where fescue is grown. Careful consideration should be given to choosing new varieties. A new variety that is simply *"endophyte-free* " will be of little or no value if it is not well adapted, In view of reduced stress tolerance of EF fescue, the area of adaptation may be slightly less than for El fescue, and a higher level of management will be required for successful establishment and for long-term persistence. University trials are a good source of variety information.

Methods of Replacing El Stands Include:

A. Rotation - Rotating with other crops, followed by seeding EF, is an excellent approach. There are many options ranging from no-till corn or a summer annual forage such as pearl millet, to longer term rotations involving a perennial such as alfalfa or two or three annual crops.

B. Prepared Seedbed - Certain situations permit destroying the old sod through tillage, preparing a seedbed, and then replanting EF fescue. However, it is often difficult to completely destroy an old fescue sod by tillage.

C. Chemical Kill No-Till – Where methods A and B are not feasible, chemical kill of El fescue in the fall, followed by no-tillage planting the following spring with EF fescue or another forage mixtures the only remaining option. It is critical that chemicals be used effectively, thus killing all the existing El fescue. Effective sod kill requires attention to label instructions and striving for optimum environmental and plant conditions that will permit greatest chemical effectiveness. Consult state recommendations on chemicals, rates, restrictions and time of application.

Best results are often with spring seedings. Although chemical kill has been satisfactory in spring, summer drought and weed competition can reduce stands of spring-seeded fescue.

In order to prevent later establishment of volunteer infected plants, any El field which is to be replanted should not be allowed to produce seed for a year or more before re-seeding. Seedhead formation should be prevented by heavy grazing, clipping or chemical application.

Under usual storage conditions, the endophyte will die in seed within one or two years. Thus, volunteer plants from old seed will usually be EF or have a very low level of infection. Unfortunately, the germination level of fescue seed can drop sharply during long term storage, depending on temperature and humidity conditions. Furthermore, the vigor of seedlings resulting from planting old seed is likely to be reduced.

Establishing New Fescue Stands

When planting a new fescue field for livestock in an area where fescue is well adapted, a livestock producer should use non-infected seed, assuming overgrazing of the EF stand will be avoided.

The importance of knowing the level of endophyte infection in seed can hardly be over-emphasized. The dramatically increased beef production on EF fescue can be expected every year for the life of the stand!

It is highly desirable to plant a legume companion species with fescue, especially with El fescue. The optimum approach is to seed tall fescue in late summer/fall, then plant clover in late winter or early spring or the following late summer. Legumes may dominate EF fescue if planted at the same time. Kentucky research indicates that clover in a EF stand will further increase young animal gains by 0.2 pounds per animal per day. However, the primary justification for planting a legume with EF fescue is to reduce N fertilizer expense.

Red clover, seeded at the rate of 4 to 8 pounds per acre, is the best legume companion in most fescue pastures. However, white clover, at a rate of 1 to 3 pounds per acre broadcast or drilled, is another good possibility. Other legumes such as birdsfoot trefoil or alfalfa may also be used.

New Approaches to Managing the Fescue Endophyte

Researchers in New Zealand have isolated a strain of endophyte fungus that can provide a unique set of traits to the endophyte problem. The alkaloids produced by this 'novel endophyte' strain impart the plant vigor traits to the plant without the associated problem alkaloids that adversely affect the animal. This novel endophyte can be easily introduced into fescue varieties. The hope is that fescue with the novel endophyte will persist and withstand stresses better than EF varieties and still provide the livestock production benefits. To date the novel endophyte has been incorporated into 'southern' fescue varieties, whose persistence in Iowa is unknown. Other seed companies are also working with novel entophytes with fescue varieties with more 'northern' adaptation. It is still too early to know whether first the existing EF varieties are as productive as those with novel endophyte in our more northern, less stressful environments. Watch for new research findings with theses new varieties from the upper Midwest states research.

Reference

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